

ZOOLOGICAL RESEARCHES.

MEMOIR V.

On Polyzoa, a new animal discovered as an inhabitant of some Zoophites — with a description of the newly instituted Genera of Pedicellaria and Vesicularia, and their Species.

LINNÆUS whose vast and transcendant genius shed an equal lustre over the whole domain of Nature, would appear to have been the first to collect into one great assemblage (as an Order of his Class of Vermes) the various aquatic productions which under the disguise of Plant-like forms, seemed more nearly allied to the animal kingdom, and thence named Zoophites or animal-plants — these productions although in no way remarkable for their colouring, and many of them insignificant in point of size, are nevertheless amongst the most curious and interesting of Nature's works, embracing the principal part of the *compound animals*, or such as appear to be composed of a number of individuals united together and enjoying a life common to the whole ; this interest is farther enhanced by their appearing to have contributed no small share towards the changes which have taken place, and still continue to operate in modifying the crust of the Globe : the prodigious quantities of them which people the bottom of the Ocean

and often raise themselves to its very surface, is scarcely to be conceived by those who have not visited the warmer regions of the globe, where they appear at present to be in most active operation, at times extending themselves in an almost continuous sheet over the undulations and anfractuositities of the bottom of the sea for many leagues, and hundreds of leagues, forming submarine meadows and thickets of vast extent, that yield protection and cover to myriads of animals which lurk between their folds and contortions, or sport amongst their branch-like forms.— In texture some are fleshy, others fibrous, horny, or apparently lapidescent, and in form more various and dissimilar than the Lichens, these being the vegetables to which they most approximate in this respect; indeed until the beginning of the Eighteenth Century they were generally considered by Naturalists as Plants, yet Gesner in 1565, Imperati in 1599, Boccone in 1674, Shaw in 1638 and 1646, and some other Naturalists, had observed and described the animal inhabitant of several. To Peysonnel however must be given the chief merit of having drawn the attention of Naturalists to their real nature in his Memoirs presented to the Royal Academy of Sciences in 1727, and to the Royal Society of London and published in their Transactions for the year 1752—in these memoirs he has described the animals of many Madreporæ, Milleporæ, Gorgonias &c. To these interesting discoveries of Peysonnel, followed the no less important one of the naked Polypi by Trembley [See Trans. Roy. Soc. Vol 42, 43 and 44.] These were subsequently named Hydrazæ by Linnæus and have been considered as the animal inhabitant (under certain modifications) of the greater part of the Zoophytes. In order to be enabled to appreciate the value of this opinion it will be necessary to understand the structure of these Hydrazæ, which are eminently simple, soft, dilatable, and extensile, furnished with but a single central mouth or opening above, through

which the undigested part of their food is finally ejected ; this opening is surrounded by a number of prehensile tentacula capable of a remarkable degree of *extension* and *contraction* ; in their growth they resemble plants, pushing out branchings and ramifications, each branchlet forming a complete individual ; they appear to be entirely divested of any *regular* system of organs, circulating, nervous, or generative.

The Naturalists who have subsequently most contributed towards the knowledge of these Hydræ, are Bernard de Jussieu, Guetard and Donati ; but it is undoubtedly to Ellis we are under the greatest number of obligations for the length to which he prosecuted their natural History, and the descriptions and figures with which he has enriched this branch of knowledge.

Later investigators threw no new light upon these animals, so that Naturalists were satisfied of the identity of the animal inhabitant, and of the propriety of assimilating them in one connected group or Class, since however, that it has been deemed necessary to examine more minutely into the anatomical structure of animals, these notions have been disturbed by the discovery made by Renier in 1793. (*Opusc. scelt. tom. 16 p. 256 t. 1.*) that the animals of the Botryllus Stellatus were not Hydræ but Ascidie, and consequently appertaining to the *Mollusca acephala*, animals of a much higher Order, having a distinct respiratory organ, a mouth distinct from the Anus, a stomach, intestinal canal, ovaria, &c. It was reserved to Mons. Savigny however in 1815 and 16 to demonstrate that numberless Linnæan Aleyonii possess analogous animals with the Botryllus Stellatus.* To these important dis-

* Mem. sur les animaux sans vertebres. The designs which accompany the first of these Memoirs, M. Savigny says, were executed in 1810 and the Memoirs made known to the Institute in February 1815. Subsequently Messrs. Desmarests, jun. and Le Sueur (to whom these discoveries must have been known) analysed with equal success the animals of the Botryllus Stellatus and of the Pyrosoma.

coveries may be added those made by Le Sueur (*Trans. Acad. Nat. Sciences of Philadelphia*, Vol. 1. p. 176 t. viii.) that the animals of various Madreporæ, of the Genera Caryophyllea, Astrea, Meandrina, &c. possess a considerably more complicated structure than Hydra, and one more nearly approaching to that of Zoantha and Actinia.

These several discoveries while they point out the dissimilar structure of the animal in the Zoophites, open a vast field for exploration.

The present Memoir has for its object to demonstrate another form of animal not hitherto known, and which while it must be allowed to belong to a new type of the Mollusca acephala, resembles exteriorly in some measure the Hydra, this animal has been designated by the name of Polyzoa, because it appears to be quite peculiar to the compound animals, and unlike Hydra, Actinia and Ascidia has never been observed in a single and separate state. The Polyzoa will probably be found in many dissimilar Genera of the Zoophites, and even mixed up with Hydra in some, as they appear to be in the Sertularia of authors, and hence this discovery must be the cause of extensive alterations and dismemberments in the Class with which they have hitherto been associated. Thus this discovery will remove that portion of the Sertularia not provided with distinct oviferous receptacles, to the class Mollusca acephala, as well as such other genera as may hereafter be found similarly circumstanced. I shall merely indicate here in a general way the whole of the Flustracæ, in many of which I have clearly ascertained the animals to be Polyzoæ.

If amongst the Genera of the class of Zoophites, there is one which resembles a vegetable production in general appearance, roots, rapidity of growth and limited duration, more than any other, it is certainly that of Sertularia, a family so admirably illustrated by Mr. Ellis in his Natural

History of Corallines; it embraces, as at present constituted, a numerous assemblage of Plant-like animals of delicate and beautiful forms, composed of a tubular corneous substance, filled by the internal connection of the animals, which unites them together into one community, the animals showing themselves like so many stellate flowers from cells variously disposed along the stems and branches.

Linnæus first instituted this Genus, including in it all the *tubular* corneous, and crustaceous Zoophites, and even several decidedly cellular. The subdivision of this heterogeneous family has consequently devolved upon the Naturalists of the present day, who have formed out of it a number of new genera, thus, Lamarek (*Hist. Nat. des Anim. sans Vertebres*) has Campanularia, Plumularia and Antennularia, Sertularia and Serialaria, formed out of the corneous Species alone; more lately Mons. Lamouroux, who has devoted his attention almost exclusively to Marine productions, (*Hist. des Polypiers flexibles*,) has increased the number of Genera to double the above amount, but, it is to be regretted, without having even adopted the names of those previously indicated by Lamarek, at the same time that he has enriched it with some new types: still, from the want of acquaintance with the animal inhabitant, both have left their Sertulariæ more or less heterogeneous.

As a whole, the Sertulariæ of Linnæus present us with the singular and unexpected result, of productions under great similitude of external appearance inhabited by animals not even Classically related!

In prosecuting the study of Marine productions, the Sertulariæ have fallen in an especial manner under the notice of the author, and presented a number of interesting results, but none so remarkable as the discovery of an animal inhabiting the presumed Sertularia imbricata of Adams? (*Trans. Linn. Soc. Vol. V, t. 2, f. 5-11*,) of a

totally different description from those the author had previously observed in the Campanulariæ, Plumulariæ, and genuine Sertulariæ of Lamarck, which are undoubted Hydræ. This new animal, the Polyzoa, was subsequently found in Sertularia Cuscuta, Spinosa, and Pustulosa, and will, no doubt, be found in all the other species not furnished with oviferous conceptacles, distinct in size, shape and situation from the cells occupied by the animals, and consequently in all the Sertularia of Lamarck.

The *Sertularia imbricata* of Adams being very imperfectly observed and figured, has scarcely been acknowledged by Naturalists as an animal production ; it is, in the harbour of Cove, one of the most obvious and common species, appearing as an amphibious parasite (Pl. I, f. 1.) on various littoral Fuci, particularly *F. serratus*, creeping over their surface by means of it's tubular ramifying roots, and throwing off numerous flaccid irregularly branched shoots to the length of from one inch to one and a half or more, often so densely clustered as entirely to cover the Fuci on which it grows ; the branches of this species go off in an alternate order from the stem and branches, decreasing in length from beneath upwards, and support at short intervals clusters of oblong sessile vesicles,* imbricate or densely compacted, and unilateral in regard to the part of the stem on which they are respectively placed ; (f. 2,) these clusters vary in the number of individuals, from three to near twenty, with the intervals between the clusters at times short and indistinct ; the vesicles however are merely crowded and have no connexion with each other, except through the medium of the tubular stem on which they repose. When placed in sea water, the animals of this species shew themselves more freely and in greater numbers than those of any other submitted to examination. In their retracted

* Vesicle is here used to signify the cells actually occupied by the animals, and not as applied to the true Sertulariæ where it means a larger description of cell or pod occupied by eggs only.

state the vesicles appear shortened and closed at the mouth (f. 3,) but from their translucency show the included animal with its arms closed together, (but neither shortened nor folded as they are in *Hydræ*,) with its body bent up, and lying in the bottom of the vesicle; when the animal protrudes, the closed mouth of the vesicle rolls outwards and extends, appearing to be continuous with the body of the animal, the arms or tentacula shoot out and spread into a funnel-like form, at the same time that the body of the animal becomes erect, (f. 4,) in this state it is easy to perceive the whole structure of the animal, its arms, gullet, stomach, intestine, and ovarium. The arms, (f. 4, a.) in this species are *ten* in number, half the entire length of the animal, and almost linear, and although incapable of any individual shortening or retraction, as in *Hydræ*, are extremely flexible, and have a range of delicate laminæ along their sides and front, which are kept in constant and rapid movement during their expanded state, calculated to produce a current towards the mouth and probably replacing the branchial apparatus of the *Ascidie*, as a somewhat analogous contrivance has been observed in the Moluscous Genus *Clio*. The mouth is placed within the circle formed by the arms, from which the gullet, (*b*,) extends downwards to the stomach, (*c*,) which occupies the middle point of the vesicle, and is of a roundish figure and fleshy substance; from the lower part of the stomach the intestine, (*d*,) bends upwards along the front towards the edge of the vesicle; in it, scybala or rounded pellets of dark encrementitious matter may generally be observed. By attentive observation a muscle may be seen to act in drawing up the animal, originating near the margin of the vesicle above, and inserted into the animal beneath the stomach; no doubt, it possesses an antagonist calculated to draw the animal within its cell, and originating of course, in the lower part of the vesicle. From the stomach, the viscus

(*c*,) appears to descend considerably lower, and from its acquiring a spherical shape, opaque yellowish colour, and its persisting after the death of the animals in many of these Zoophytes, is most probably an ovum or ovarium, and quite analagous in situation, with the same organ in the lately discovered compound Ascidiæ.

The discovery of the Polyzoa was made in the summer of 1820 ; during the subsequent and following seasons, an exactly similar structure was noticed in the other species above enumerated, and in a new type which perhaps merits to be distinguished as a separate genus, under the title of *Pedicellaria*,* (Pl. II. f. 5, 6, 7,) as the vesicles are single and *terminal*, each supported by a simple pedicle, originating in a scattered manner, from creeping, slightly branched tubular roots. The *Pedicellaria* was discovered on the bottom of a ship from the United States, mixed with *Campanularia Aucta*, (a new species) and other marine productions. In this type the arms are *twelve* in number, and the mouth of the animal and tentacula when protruded, incline in a remarkable degree to one side. I for some time thought the *Sertularia Syringa* might belong to this last type, as it has not been observed to produce any oviferous conceptacles, and although remarkably smaller, bears a considerable resemblance to *Pedicellaria*, but as its animal has been since ascertained to be a *Hydra*, its relation to *Campanularia* remains undisturbed.

The Comparative Anatomist will find no difficulty in tracing a considerable agreement in structure between Polyzoa and that of the compound Ascidiæ so admirably developed and so elegantly figured in the Memoirs of Mons. Savigny ; the Polyzoa however are still essentially different, and this difference consists principally in the substitution of external prehensile tentacula, to which the branchia or respiratory

* Muller's genus *Pedicellaria*, had been erroneously founded on certain productions mixed with the spines in *Echini*, which are certainly nothing but peculiar organs belonging to the animal.

organ is appended, in place of the internal branchial sac of the compound Ascidiae. These last (the compound Ascidiae) on a general view, having a lobed or valvular opening, leading to a capacious branchial cavity or sac, over the parieties of which the branchia are distributed; at the bottom of this cavity is found the real mouth of the animal, leading through a gullet more or less long to the stomach, which is thick and muscular; from the lower end of this, the intestine issues and shortly bending upwards, terminates near the front of the branchial opening; the ovarium is either situated in the fold formed by the intestine on one or both sides of the animal, or is appended to the lower part of the fold, and sends its oviduct upwards along the course of the rectum; all these parts are included within a common or exterior tunic, whether the individuals are simple or compound.

The other species of Sertularia in which the animals have been determined to be Polyzoe, may, together with Sertularia imbricata of Adams, perhaps, be referred to *one* Genus, although they differ remarkably in habit, in the arrangement of the vesicles, and even in the number of tentacula, which vary from eight to ten, being in Sertularia Pustulosa, Spinosa and Cuscuta 8, in S. imbricata 10. To this Genus the name of Vesicularia may not be thought inapplicable, and as the individuals which compose it have been hitherto very imperfectly understood, a short description of each, illustrated by magnified figures, must prove satisfactory to the Zoological Student.

Vesicularia Cuscuta (Sertularia of authors,) (Pl. II. f. 1.) bears some slight resemblance to V. imbricata before described, in the flaccidity of its branches, and the irregular distribution of its vesicles, these however on close examination are found to be much fewer in number and much more scattered, at the same time that the whole is infinitely smaller, being indeed the most delicate species known,

while its flexuose shoots often extend to the length of several inches, very much like the plant from which it has obtained its trivial name (viz. *Cuscuta* or *Dodder*.) The main stems originate from tubular creeping roots, which invest marine plants in shoal water, these stems are often jointed at unequal distances, and give off a number of short branches, which originate in pairs from its opposite sides, frequently just above a visible joint; these branches support the vesicles, which are scattered over their surface in an irregular manner, and do not differ except in size and number of tentacula, from those of *V. imbricata*; the tentacula being 8 in number. (f. 4.)

Vesicularia spinosa (*Sertularia* of authors) (Pl. III. f. 1.) is indeed a production of the greatest beauty and delicacy when in its prime, and of quite a peculiar air and habit, the vesicles however with their animals exactly accord with those of the last species, only that the former are more turgid or of an oblong oval shape. The stem in this species rises from a tuft of tubular intricate roots, and is more or less thick in proportion to the age of the individual, a circumstance also met with in some of the true *Sertularia* (viz. *Campanularia verticillata* and *Sertularia Halecina*,) and as its thickening arises from the constant addition of fresh radical tubes to its outer surface, it is probable that every new branch in these species sends downwards its radical tube along the surface of the stems, so as to give them the requisite strength, in proportion to the growth of the upper part; this stem sends off branches in an alternate and irregular order, which are erect and zigzag, and become extremely fine towards their upper extremities; at each angle of the zigzag, a pair of short repeatedly dichotomous branches are given off, the last divisions ending in sharp or spinous-like points. (f. 5.)

The joints of the stem, as well as the joints of the branchlets, are each provided with a row of three prominent holes

on their upper surface, upon which in many we perceive an equal number of oval transparent vesicles, or towards the extreme parts of the branches, embryo vesicles. The animals are very easily seen in all their details in this species, from the great transparency of the vesicles, and are provided with *eight* tentacula. (f. 7, 8.)

Vesicularia pustulosa (Sertularia of authors). This species, very imperfectly known from the perishable nature of its vesicles, first offered itself to notice without them and as represented by Ellis N. Hist. of Corallines Pl. XXVII. *b*, B. but was subsequently discovered in its perfect state (Pl. I. F. 5.) It arises from the surface of marine fuci with a straight flexuose stem, to the height of two or three inches, giving off at each flexure a spreading branch, which in like manner gives off secondary ones, all however, both primary and secondary, lying in the same plane, they are hence what Botanists term distich; each flexure of the stem and branches and each terminal branchlet is composed of a distinct joint, each of which are perforated by a double row of holes from 6 to 18 with elevated margins, fig. 7, 8, on all of which in perfect specimens are placed oval transparent vesicles, furnished with animals having 8 tentacula, fig. 10 11; the rows of perforations having a spiral tendency, the clusters of vesicles hence present themselves in every direction (f. 6,—) this species approximates in this last character and in the unilateral regular disposition of its vesicles to *Serialaria*, from which however all the *Vesiculariæ* differ in the vesicles being *free* and not as in that genus agglutinated together in series or connected lines. Although the animals of the *Serialaria* have not as yet been observed, yet from the above coincidences and no oviferous vesicles distinct from the others having been seen upon them, there can hardly be a doubt but they are the habitations of Polyzoeæ and not of Hydræ, and consequently would find place in our Systems next to *Vesicularia*, and distinguished as a genus by

the vesicles being confluent or united together by their sides, either in interrupted series or apparently continued lines.

Time and more accurate observation will no doubt add many more species to the above Genera, even from amongst the Sertulariæ already known ; thus the Sertularia cedrina, obsoleta and pinus of Gmelin are probably Vesiculariæ, as well as Sertularia uva of Ellis which might be considered as the young state of Vesicularia imbricata but for the statement of that acute observer, that the animals possess only *eight* arms, whereas in the latter they are provided with 10.

POLYZOA.

PLATE I. Fig. 1, *Vesicularia imbricata*, a principle stock of its natural size.

Fig. 2. One of the terminal branches magnified, showing the animal in different states of projection.

Fig. 3. One of the vesicles highly magnified with the animal in its retracted state.

Fig. 4. The same with the animal in its state of extension: *a*, tentacula. *b*, gullet. *c*, stomach. *d*, intestine. *e*, ovarium. Two pellets of excrementitious matter are seen in the intestine.

Fig. 5. *Vesicularia pustulosa*, in its perfect state when full grown, natural size.

Fig. 6. A branchlet magnified, showing the sub-spiral distribution of its groups of vesicles.

Fig. 7. A branchlet highly magnified, partly denuded by the falling off of the vesicles, showing the exerted animals, and the articuli into which it appears to be divided.

Fig. 8. One of the terminal shoots, without its vesicles, magnified.

Fig. 9. A vesicle with the animal in its retracted state, magnified.

Fig. 10. A vesicle with its animal exerted, magnified. *a*, tentacula. *b*, gullet. *c*, stomach. *d*, intestine. *e*, ovarium.

Fig. 11. The tentacular head more highly magnified.

PLATE II. Fig. 1. *a*, Natural size of a principal stock of *Vesicularia Cuscuta*. *b*, the same magnified.

Fig. 2. A terminal shoot from which the vesicles have fallen off, showing the irregular distribution of the perforations on which they were placed.

Fig. 3. A vesicle highly magnified, with the animal in its retracted state.

Fig. 4. A vesicle with the animal in its extended state. *a*, tentacula. *b*, gullet. *c*, stomach. *d*, intestine. *e*, ovary.

Fig. 5. *a*, *Pedicellaria exotica* of its natural size. *b*, the same magnified, showing a number of individuals originating from one of the radical tubes.

Fig. 6. A vesicle highly magnified with the animal retracted and bent up as usual into an *S* like form.

Fig. 7. A vesicle highly magnified with the animal extended, its details obscured by the greater opacity of its parieties.

Fig. 8. One of tentacula more highly magnified showing the respiratory lamina in profile.

PLATE III. Fig. 1. A principal branch of *Vesicularia spinosa* of the natural size.

Fig. 2. A dead branch stript of its vesicles, as usually seen amongst the rejectamenta of the Sea.

Fig. 3. The basis of an old stock formed by an accumulation of tubes, giving rise to branches similarly constructed, magnified.

Fig. 4. Three joints of a main branch magnified, showing the manner in which the vesicles were distributed upon it, and the ramuli given off in pairs.

Fig. 5. One of the two ramuli which are given off at each articulation of a branch highly magnified, and still retaining a portion of its vesicles, from some of which the animals are seen projected, while others appear not to have reached their state of perfection

Fig. 6. One of the vesicles very highly magnified with the animal in its retracted state.

Fig. 7. One of the vesicles with the animal extended. *a*, tentacula. *b*, gullet. *c*, stomach. *d*, intestine with scybala. *e*, ovary.

Fig. 8. Front view of the tentacula and open mouth of the animal.

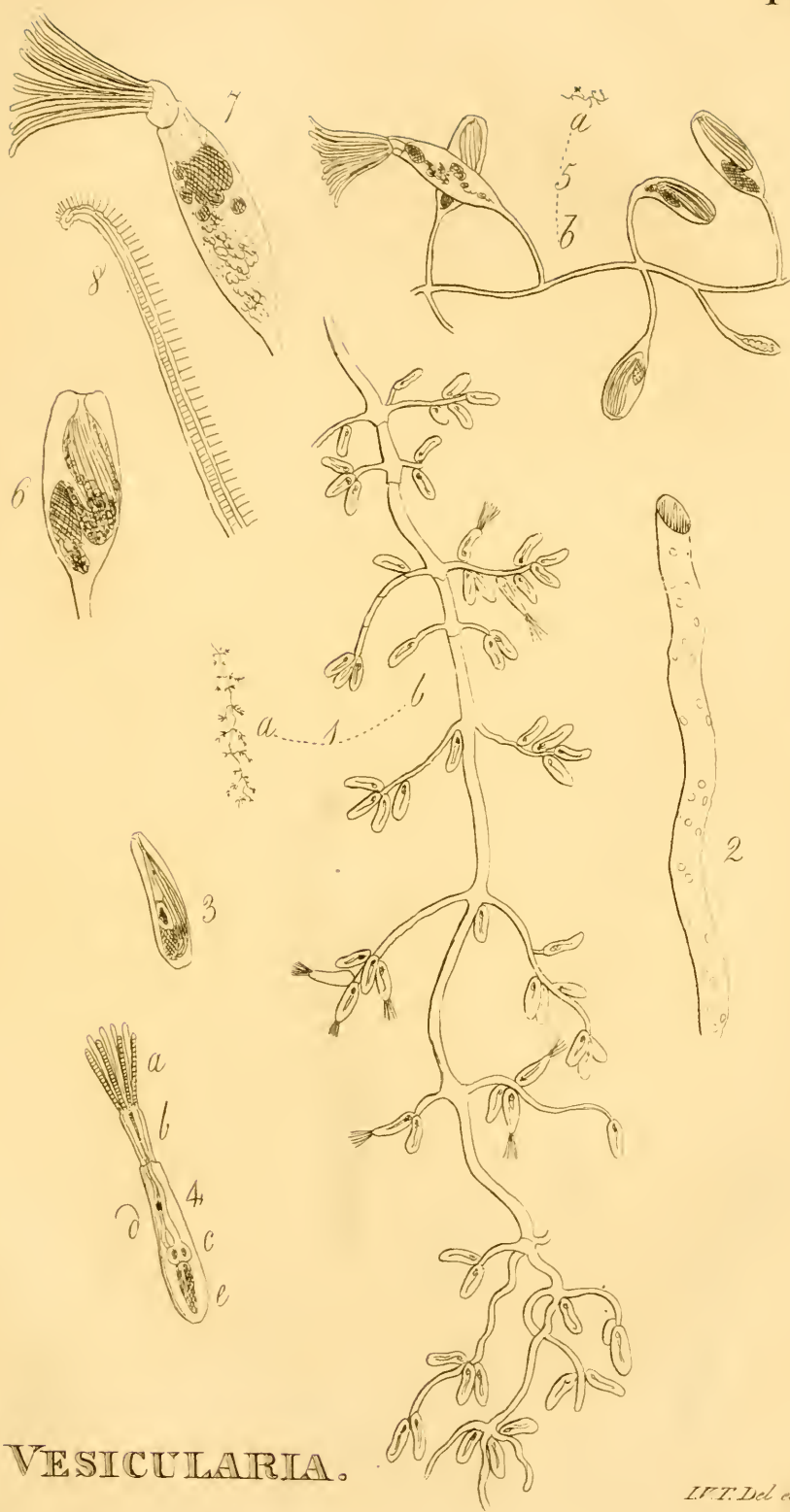
Fig. 9. *a*, One of the tentacula rolled upon itself at the extremity. *b*, a tentaculum wholly revolute.

END OF PART I.



VESICULARIA.





VESICULARIA.



VESICULARIA.

